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TWO SPECIES OF MACROSIPHUM.

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BULLETIN 190.

MACROSIPHUM DESTRUCTOR AND MACROSIPHUM SOLANIFOLII.*

EDITH M. PATCH.

Because of their similarity and the consequent lack of satisfactory specific characters in descriptions, many of the aphides belonging to the genus *Macrosiphum* have become confused both as to their status in literature and in collections. Some 12 years ago I questioned one of our most careful aphidists concerning *M. pisi* and he replied with a laugh, "Pisi! Well, that's a composite species all right. All big green *Macrosipha* not otherwise easily placed are *pisi.*"

A few years ago a second aphidist who has spent many years working over these insects told me with a half whimsical shrug of despair, "If an aphid is a *Macrosiphum,* then I do not know the species."

It was with this confusion in mind that a critical examination of *solanifolii* was undertaken for characters which would separate it from closely allied species. I found that this aphid has been listed as *"pisi"* in certain aphid collections and presume that it may be mixed with *"pisi"* in literature. What *pisi* Kaltenbach is I do not know. There seems to be no reason to be sure that *pisi* has not been a composite species in Europe as well as in America both in collections and in literature. It is on account of this uncertainty that in this paper the whole *pisi* proposition is relegated to Europe where it should first be straightened out and "the destructive green pea-louse" of

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America is discussed under the name of *M. destructor* (Johnson) which is conservative and safe for the present.

Both *destructor* and *solanifolii* may be characterized as large green *Macrosipha* with not infrequently color varieties of bright pink or soft yellow. For the most part the characters which separate them are relative, as *destructor* is in general larger with longer, more slender cornicles and a longer cauda. The antennal characters differ somewhat, the most distinctive difference being in the sensoria of the spuriae, this form in *solanifolii* having the sensoria of III about 3 to 6 and arranged at the base of the segment more in a row than in *destructor*, the spuriae of which have the very few sensoria (1 to 3 or 4) of III rather bunched at base of segment. But the most definite and easily observable of characters which will serve to differentiate these two species is the presence or absence of reticulation of the cornicles, a character mentioned by Sanderson (1910a) in his interesting and suggestive comparative study of European and American specimens of *"pisi."* Mr. Sanderson, however, did not consider this character to be of specific importance although he mentions the presence or absence of reticulations in his descriptions and figures of the cornicles with reference to this character, and gives (Sanderson 1901a p. 74) *reticulata* as a variety name to those *Macrosipha* (chiefly from lettuce) having reticulated cornicles and more numerous sensoria on antennal segment III of the apterous viviparous form, (Sanderson 1901a p. 38).

Whether *reticulata* Sanderson may prove to be *solanifolii* or not, I have at present no biological evidence to indicate; but the structural characters of antennae and cornicles would separate *reticulata* from *destructor* and show that it is at least closely allied to *solanifolii*. What the full synonomy of any of these similar species of *Macrosiphum* may be it would be folly to guess until the whole group is more thoroughly understood; but it does not seem futile to attempt to characterize *destructor* and *solanifolii* so at least that these two species may not be confused regardless of the host plant upon which they are taken.

Mr. Sanderson in concluding his careful and valuable paper (1901a pp. 38-39) writes: "For the present, therefore, from the material studied, we are obliged to consider all of these

specimens as varieties of *N. pisi* Kalt. A larger series and further observation of their life histories may reveal specific distinctions. The present account is published merely to show the extreme variability of this species (or, as it may prove to be, the likeness of several species), and the necessity of a careful study of it and allied species."

The purpose of this present paper is merely to add one more chapter toward the interpretation of two similar species, a chapter that seems necessary in connection with the biological and food plant data of these species which is needed before the economic status of these insects can be clearly understood. In regard to the need for further host plant data Mr. Chittenden (1909) writes:

"The subject of alternate host plants is an important one, since the pea, being an annual, is not available as food for this aphis during the winter. It is desirable to ascertain all of the host plants of the pea aphis, and more especially the weeds, as some one or more of these may be factors of importance in the life economy of the species. It might be necessary in the future, should the depredations of this insect increase, to limit the growing of clover and other legumes, as well as their alternate host plants, if such be found, in the vicinity of pea fields. If all of the principal alternate plants could be discovered this might furnish a solution of the problem of how to deal with the insect."

The futility from an economic standpoint of compiling a series of host plants for a "composite species" is apparent.

The descriptions of *destructor* in the Bibliography appended with especial reference to the beautiful figures (Folsom 1909) in the Illinois Report are still easily available and suffice, together with Miss King's figures of the cornicles in this present paper, sufficiently to characterize the Destructive Green-Pea-louse. The imbrications of the cornicles extend clear to the tip in both apterous and alate forms, there being no terminal area of reticulation as is the case in *solanifolii*.

This imbricated character of the *destructor* cornicle holds good in forms much diversified as to color and size, as both pink and green varieties are alike in this structure. It also holds good for the progeny individuals transferred from pea to shepherd's purse and clover. The distinctions between the

reticulated and imbricated cornicles of any species of *Macrosiphum* come out only in the mature insect and do not hold useful for the nymphs.

In general *Macrosiphum solanifolii** is a large, active species, usually green but very often pink, and sometimes yellowish, especially the young of the pink individuals.

Decidedly pink individuals occur both with the winged and apterous viviparous females. At Houlton, August 17, 1905, a pink-winged viviparous female was taken with 12 young, 7 of which were decidedly green and 5 decidedly pink. About 20 pink viviparous specimens collected at Maple Grove, August 19, 1906, were placed upon potato in the insectary. Some were winged and some were apterous. On August 29 the young of these were all found to be pink, though many were toning into pale yellow. The insectary specimens of oviparous females were largely pink, though many were yellow, and a few distinctly green.

Macrosiphum solanifolii. Winged viviparous female.—Head yellowish green. Antennae, proximal segments pale green, distal segments dark; length of segments: III, .88 to .96 mm.; IV, .76 to .9 mm.; V, .64 to .72 mm.; VI, .16 to .2 mm.; VII, .96 to 1.12 mm.; total length I to VII, 3.6 to 4.05 mm. Prothorax and thorax light yellowish green. Wings hyaline, veins dark brown, very slender, stigma pale brown. Total wing expansion 8.1 mm. Legs with proximal part of femora and tibiae pale, tarsi and distal part of femora and tibiae dark. Tarsi .16 to .2 mm. Abdomen light green unmarked dorsally or ventrally. Cornicles, with proximal portion green and distal portion dark brown, imbricated along the center but strongly reticulated at tip, cylindrical, length .95 mm. or about five times length of tarsus. Cauda light green, ensiform, length .48 mm. or about one-half length of cornicles. Total length of body to distal tip of cauda and exclusive of antennae 2.9 to 3.37 mm.

Winged viviparous female, pink individual.—Head light yellowish. Antennae with I and II light yellowish, rest dark. Prothorax and thorax light yellowish pink. Abdomen pale pink. Cornicles light yellow with tips dusky and strongly reticulated. Cauda pink.

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*For a fuller discussion of this species the reader is referred to Bulletin 147 of the Maine Agricultural Experiment Station.

Apterous viviparous female.—Color as with the winged viviparous form. Antennae, length of segments: III, .8 to .96 mm., IV, .72 to .88 mm., V, .56 to .72 mm., VI, .16 to .2 mm., VII, .96 to 1.2 mm., total length of segments I to VII, average about 4.05 mm. Cornicles .96 to 1.04 mm. in length, and strongly reticulated at tip. Cauda .56 mm. Total length of body to distal tip of cauda and exclusive of antennae, 4.05 mm.

Apterous oviparous female.—Head pale, nearly white. Antennae with proximal joints pale, distal half dark. Length of segments: III, .68 to .88 mm.; IV, .56 to .68 mm.; V, .52 to .64 mm.; VI, .16 mm.; VII, .96 to 1.04 mm.; total antennal length I to VII average about 3.6 mm. Prothorax and thorax pale like head. Legs with femora and tibiae, proximal portion pale, distal portion dusky. Tarsi dark, .16 mm. long. Hind tibiae conspicuously darker and much swollen and thickly set with sensoria. Abdomen light salmon pink. Cornicles pale at base, distal half dark and reticulated at tip; length .6 to .8 mm. Cauda salmon pink, ensiform, length .32 to .4 mm. Total body length to tip of cauda, antennae excluded, 2.13 to 2.15 mm. The size of the hind tibiae of this form makes it readily distinguished from the apterous viviparous form and young, even to the unaided eye.

The pink variety has been described because these predominate among the oviparous females. The color scheme of the green and yellow forms can be determined merely by substituting these colors for the salmon pink of the individual described, the dark coloration being the same for all 3.

Winged male.—Head and antennae dark brown. Length of antennal segments: III, .72 to .8 mm.; IV, .48 to .64 mm.; V, .48 to .6 mm.; VI, .16 mm.; VII, 1.04 to 1.28 mm.; total antennae length I to VII, 2.93 to 3.60 mm. Prothorax and thorax dark brown. Wings deflexed, hyaline, veins dark and very slender, stigma pale brown. Legs brown, darker at tips. Abdomen brown. Cornicles pale brown, dark distally and reticulated, cylindrical, .48 to .56 mm. long. Total body length exclusive of antennae and cornicles, 1.12 to 1.57 mm. The thorax is large and strong, the abdomen much shrunken and is rendered conspicuous only by the long cornicles. The male is described from specimens in copulation, in order that no mistake as to the identity of the species might occur.

Insectary Host Plant Tests for M. sonalifolii.

(July-October, 1907.)

By planting potatoes in the insectary often, the plant lice were supplied with fresh plants which were colonized by the individuals which deserted the plants they had rendered sickly.

Buckwheat was sown among the potato plants in the insectary and about 200 young and clean plants of shepherd's purse were put into trays. Peas were also sown at the same time. By the time the buckwheat and peas were well up about 100 fresh potato plants were available, and the *M. solanifolii,* deserting the older potato stalks, colonized thoroughly the fresh potato vines, pea vines, and the shepherd's purse apparently with no preference. Both winged and wingless forms were found for the rest of the season rearing contended progeny upon potato, and shepherd's purse, and also upon the young pea vines. Except for stray individuals which, of course, would be found upon everything in the crowded insectary, the buckwheat remained apparently untouched. Whether *M. solanifolii* would have accepted the blossom tips of the older buckwheat or not was not demonstrated, as the buckwheat, although it lived, did not make much growth.

October 11. Insectary search showed the Macrosiphum eggs near some of the oviparous forms both upon potato and shepherd's purse (*Capsella Bursa-pastoris*). Many of the eggs were glistening brownish black of well hardened eggs but some were pellucid green, showing that they had very recently been deposited. They were upon the plants indiscriminately on leaves and stalks. Males and oviparous females were present upon both these plants.

The appearance of the oviparous females and the deposition of eggs with the uncaged material at practically the same time as that of the forms that had been prisoners for 2 months would indicate that these dates are about normal. In the insectary the migration from overcrowded potato stalks to fresh plants seemed to take place irregularly and not at any stated times, the condition of the infested plant apparently influencing these movements. The fact that they seemed to seek the fresh potato plants almost as readily as the peas or the shepherd's purse might seem to indicate that if a similar succession of new pota-

toes were supplied them in the field they might not seek another host even there. As it is a wholesale migration has taken place each of the seasons these plant lice have been under observation.

The fact that *M. solanifolii* colonized readily upon garden peas in the insectary while *M. destructor* refused the potato (see page) is not without interest.

Insectary Host Plant Tests for M. destructor.

(July-August, 1908.)

The plants used for these tests were grown from seed and were kept in quarantine for the purposes of this test so that no infestation of the plants by other than the desired aphides was possible.

From Peas to Red Clover. Pisum sativum L. to Trifolium Pratense.

(a) July 21. A lot of mature specimens and nymphs, removed from peas to red clover. July 27. Mature individuals all dead. Nymphs feeding along the clover stems. Aug. 10. One winged form developed. Several living nymphs present in clover. Aug. 12. Aphides all dead. (26-08.)

(b) Aug. 10. A lot of 15 alate forms which had deserted peas (to migrate) and were present on cloth ceiling of pea-vine cage were transferred to red clover. In less than an hour these had deserted the clover as they had the peas and had gone to the sides and top of cage. No young were produced on the clover. (50-08.)

(c) Aug. 12. A lot of 10 migrants from peas placed on clover. They deserted the clover at once and did not produce. (50-08.)

From Peas to Potato Vines (Solanum tuberosum L).

(d) July 15. A lot of 20 nearly mature apterous individuals transferred from peas to potato plants. July 17. All 20 dead. No feeding on the potato took place. They would not remain on the potato but deserted it. (26-08.)

(e) July 21. A lot of 50 mature apterous individuals

transferred from peas to potato. All died without feeding or producing. (43-08.)

(f) Aug. 12. A lot of 14 alate individuals (migrants from peas) placed on potato. All died without feeding. No progeny. (50-08.)

(g) Aug. 25. A lot transferred from peas to potatoes. All died without feeding. No progeny. (50-08.)

(h) Aug. 25. A lot of apterous adults and half grown nymphs transferred from peas to potatoes. All died without feeding. No progeny. (26-08.)

From Shepherd's Purse (Capsella Bursa-pastoris (L.) to Potato.

(i) Aug. 11. A lot of 5 alate individuals removed from shepherd's purse to potato. These died without producing. (43-08.)

From Peas to Shepherd's Purse.

(j) July 17. A lot of apterous viviparous individuals and nymphs transferred from peas to shepherd's purse. In 15 minutes nearly all the aphides had already settled on the plants and begun feeding. July 21, Old aphides dead. Stalks fairly well covered with nymphs. July 31. Nymphs thriving though of a yellowish color. Aug. 6. Mature apterous and alate forms are present. These are hardly more than one-half the size of the parent forms from peas. Aug. 25. This colony still represented by alate and apterous forms feeding on shepherd's purse and producing. (26-08.)

(k) July 21. A lot of mature apterous individuals transferred from peas to shepherd's purse. July 27. Mature individuals all dead. Good thrifty colonies of greenish yellow nymphs present. Aug. 11. Seventeen winged forms present and some pupae. These are much smaller than their parents from peas. Five of these alate forms removed to fresh shepherd's purse where they at once settled and began producing, and by August 25 had developed a few winged and mature apterous descendants which were producing yellowish nymphs. (43-08.) Aug. 11. Five of the 17 alate forms (see the foregoing Aug. 11) were transferred to young pea vines where they settled, fed and produced. (43-08.)

(l) Aug. 12. A lot of 30 alate individuals transferred from peas to shepherd's purse. Aug. 25. The progeny of the foregoing are small and yellowish but a healthy, vigorous colony.

From Peas to Various Plants.

On Barley.

(m)—(x). Twelve tests were made attempting to transfer *M. destructor* from peas to barley (*Hordeum vulgare* L.). The barley was 6 inches high at time of tests and growing well. The aphides deserted the barley and crawled to the sides of the cage where they died within a few days.

On Wheat.

Four tests were made attempting to establish colonies on wheat. Two lots of 10 apterous adults were transferred from sweet peas to wheat July 27. July 31 these and their progeny were dead. One lot of 10 alate aphides was placed on wheat July 27 and by July 31 these had died. August 10 several hundred specimens were taken from peas and transferred to wheat. August 11 scarcely any aphides could be seen on the plants. August 15, aphides all dead. Wheat was 6 inches tall at time of test and growing well.

On Oats.

July 27, a lot of 10 apterous adults transferred from peas to oats. July 31, aphides all dead.

On Purslane.

July 17, a lot of 15 apterous adults transferred from peas to common purslane (*Portulaca oleracea* L.). July 21, adults all dead. No young to be found.

On Beets.

August 10, a lot of 15 alate individuals which had migrated from peas to cloth on the cage were transferred to beets in small cage. These did not remain on the beet plants but flew to sides of cage where they died before August 15.

On Squash.

August 11, a lot of 15 alate individuals transferred from peas to squash. They died within a few days without starting colonies on the squash. Test repeated with 30 nearly grown nymphs, all of which died within a few days.

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As a check against the foregoing tests, 7 lots under the same conditions in other respects were transferred from garden peas to sweet peas and from sweet peas to garden peas. All these lots established healthy colonies and thrived.

While failure to establish colonies under these conditions is not a conclusive proof that *M. destructor* never feeds on the plants refused in these tests, it is certainly strongly indicative in that direction. On the other hand, there is no reason to believe that any species of aphid will establish thriving colonies on a plant in confinement that it would not accept in the open.

EXPLANATION OF FIGURES.

Figs. 59 and 60. *M. solanifolii.* Cornicle of male and tip of same, showing reticulation. No. 22-07.

Figs. 61 and 62. *M. solanifolii.* Cornicle of apterous oviparous female and tip of same, showing reticulation. No. 22-07.

Figs. 63 and 64. *M. solanifolii,* pink variety. Cornicle of alate viviparous female and tip of same, showing reticulation. No. 106-06.

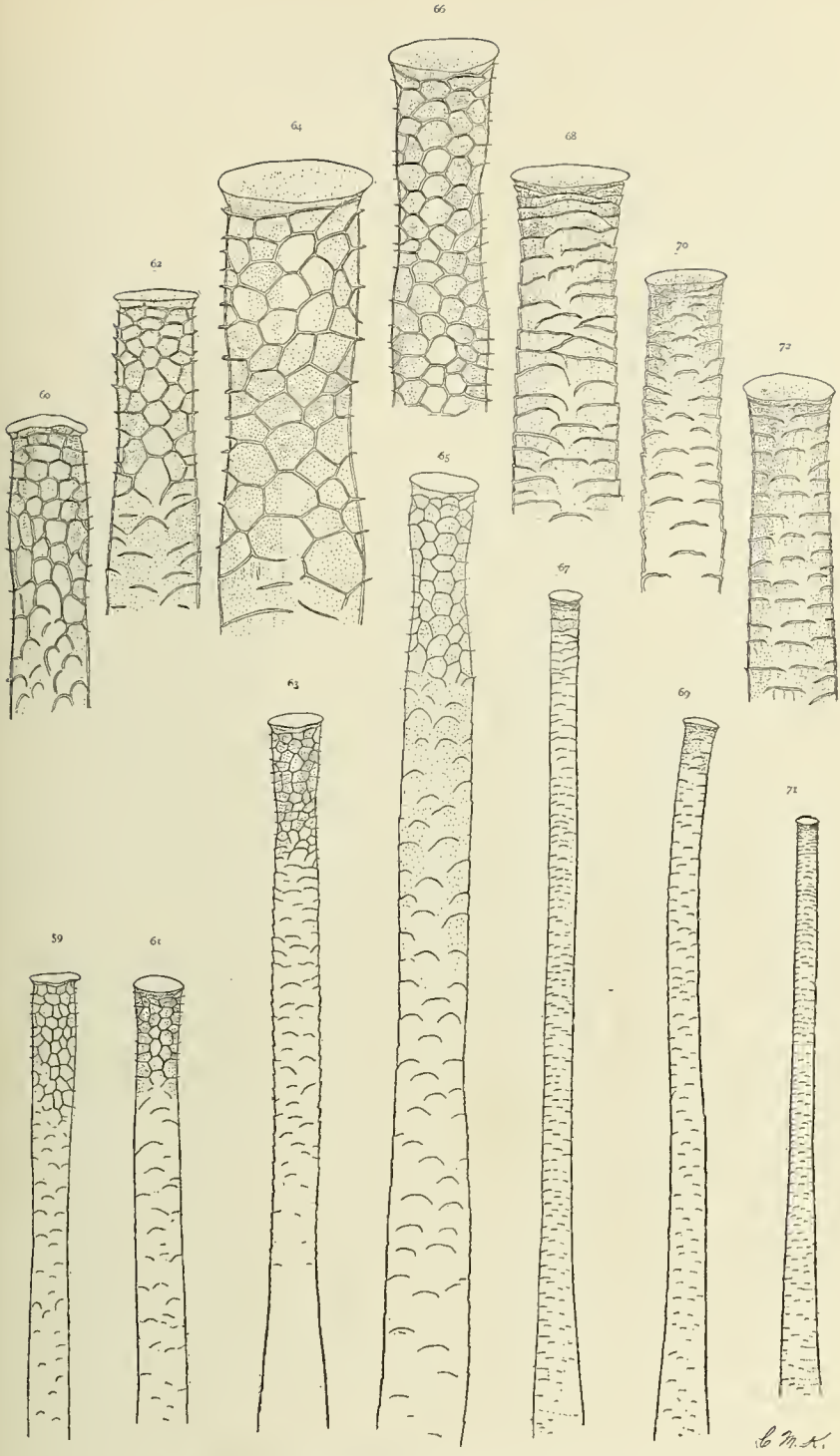
Figs. 65 and 66. *M. solanifolii,* green variety. Cornicle of apterous viviparous female and tip of same, showing reticulation. No. 50-05.

Figs. 67 and 68. *M. destructor.* Cornicle of apterous viviparous female and tip of same, showing imbrication. No. 19-07. Collected from garden pea.

Figs. 69 and 70. *M. destructor.* Cornicle of alate viviparous female and tip of same, showing imbrication. No. 19-07.

Figs. 71 and 72. *M. destructor.* Cornicle of alate viviparous female and tip of same, showing imbrication. No. 104-06. Collected from sweet pea.

(Figures were drawn by Miss Charlotte M. King.)



Macrosiphum solanifolii and M. destructor

Figures 59 to 72.

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